

## **APPENDICES**



## **APPENDIX A**

### **Geologic and Geophysical Logs**

**Graphics Legends – Soil Classification and Hole Completion**  
**Geologic Logs for Drill Hole Nos. DH-03-1 through DH-03-5**  
**Core Photographs for DH-03-1 through DH-03-3 and DH-03-5**  
**Geophysical Logs for Drill Hole Nos. DH-03-2 through DH-03-5**  
**Geologic Logs for Drill Hole Nos. DH-04-1 and DH-04-2**  
**Core Photographs for DH-04-1**  
**Geophysical Logs for Drill Hole Nos. DH-04-1 and DH-04-2**

### **Results of Geochemical Analyses**

**Summary of Samples for Geochemical Testing and Interpretation**  
**Geotechnical Test Data**



## **Geologic and Geophysical Logs**



# RECLAMATION

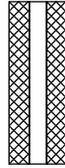
*Managing Water in the West*



Auger Cuttings



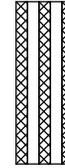
Bentonite Seal



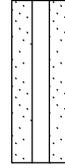
Bentonite Seal with 1 Pipe



Bentonite Seal, 2 Pipe Group with 1 Pipe



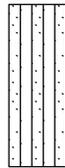
Bentonite seal, 2 Pipe Group with 2 Pipes



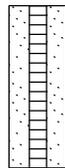
Sand Filter, 1 Pipe



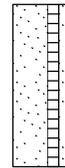
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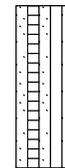
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Slotted Pipe in Sand Filter, 1 Pipe



Slotted Pipe in Sand Filter, 2 Pipe Group, 1 Pipe



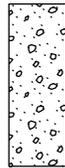
Slotted Pipe in Sand Filter, 2 Pipe Group, 2 Pipes



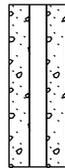
Slough to Bottom of Hole, Hole Caved, or Random Backfill



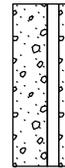
Sand Backfill to Bottom of Hole



Cement



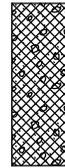
Cement, 1 Pipe



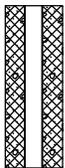
Cement, 2 Pipe Group, 1 Pipe



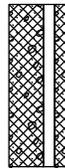
Cement, 2 Pipe Group, 2 Pipes



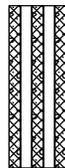
Bentonite Cement



Bentonite Cement, 1 Pipe



Bentonite Cement, 2 Pipe Group, 1 Pipe



Bentonite Cement, 2 Pipe Group, 2 Pipes

## HOLE COMPLETION GRAPHICS LEGEND



# SOIL CLASSIFICATION GRAPHICS LEGEND

GP	GP-GM	(GW)s	GP-GC	(SM)g	SC
(GP)s	(GP-GM)s	GW-GC	SP	SP-SM	SC-SM
GM	GW	GC	SM	(SP-SM)g	SP-SC
(GM)s	GW-GM	(GC-GM)s	(SP)g	(SP-SM)gc	CH
SW	SW-SC	SW-SM	(SW-SM)g	(SW)g	MH
CL	CL-CH	CL-ML	(CL)g	(CL)s	OHSH
ML	(ML)g	(ML)s	s(CL-ML)	OH	Topsoil
OL	OLSH	Pt	Boulders & Cobbles	Till	

The Unified Soil Classification System (USCS) symbols above are defined and described in Designation USBR 5005-86, "Procedure for Determining Unified Soil Classification (Visual Method)", Designation USBR 5000-86, "Procedures for Determining Unified Soil Classification (Laboratory Method)", and Engineering Geology Field Manual, Volume 1, Second Edition, 1998, U. S. Department of the Interior, Bureau of Reclamation.

# ROCK GRAPHICS LEGEND

Bedrock (Undifferentiated)	Basalt	Breccia	Chalk	Coral	Coal
Gypsum	Limestone	Sandstone	Shale	Siltstone	Mudstone
Claystone	Granite				

# OTHER MATERIALS GRAPHICS LEGEND



Asphalt



Concrete



Fill

**GEOLOGIC LOG OF DRILL HOLE NO. DH-03-1**

FEATURE: Black Rock Alternate Damsite  
 LOCATION: North of Washington State Highway 24  
 BEGUN: 12/4/03 FINISHED: 12/17/03  
 DEPTH AND ELEV OF WATER  
 LEVEL AND DATE MEASURED: Not Encountered

PROJECT: Yakima R. Basin Water Storage Feas. Study  
 COORDINATES: N 439,362.0 E 1,790,426.8  
 TOTAL DEPTH: 169.6  
 DEPTH TO BEDROCK: 146.9

STATE: Washington  
 GROUND ELEVATION: 1348.7  
 ANGLE FROM HORIZONTAL: AZIMUTH:  
 HOLE LOGGED BY: D.Stelma/R. McAfee  
 REVIEWED BY: R. A. Link

NOTES	DEPTH	% RECOVERY	SPT	ENGINEERING PROPERTIES				FIELD CLASSIFICATION	LAB CLASSIFICATION	GEOLOGIC UNIT	GRAPHIC	HOLE COMPLETION	CLASSIFICATION AND PHYSICAL CONDITION																															
				WEATHERING	HARDNESS	FRACTURE DENSITY	ROD																																					
<p>All elevations measured from ground surface and are same as driller reported.</p> <p><b>PURPOSE OF HOLE:</b> To determine the depth to the top of bedrock at the alternate damsite.</p> <p><b>DRILL SETUP:</b> Setup on original ground along the alternate Black Rock dam axis approximately 230 feet north of Washington State Highway 24</p> <p><b>DRILLING EQUIPMENT:</b> 0.0-95.0': Ingersoll-Rand A-200 truck-mounted rotary drill. 95.0-169.6': Gus Peck truck-mounted rotary drill.</p> <p><b>DRILLER:</b> 0.0-95.0': Chris Peterson. 95.0-169.6': Lenny Washburn.</p> <p><b>DRILLING METHODS:</b> 0.0-165.0': Advanced 6-inch using the ODEX system (downhole hammer and compressed air). 165.0-169.6': Advanced hole with HQ wireline core barrel (2.50" I.D.) and diamond bit using clear water as circulating fluid.</p> <p><b>DRILLING CONDITIONS:</b> 0.0-9.0': Fast and smooth. 9.0-30.0': Slow and rough 30.0-38.0': Fast and smooth 38.0-69.0': Slow and rough 69.0-75.0': Fast and smooth 75.0-89.0': Slow and rough 89.0-118.0': Fast and smooth 118.0-169.6': Slow and rough</p> <p><b>CASING RECORD:</b> 2003 Cs Depth Depth Date Sz Hole Cs</p> <table border="1"> <tr><td>12/4</td><td>6"</td><td>29.0'</td><td>29.0'</td></tr> <tr><td>12/5</td><td>6"</td><td>79.0'</td><td>49.0'</td></tr> <tr><td>12/6</td><td>6"</td><td>97.0'</td><td>97.0'</td></tr> <tr><td>12/12</td><td>6"</td><td>10.0'</td><td>10.0'</td></tr> <tr><td>12/13</td><td>6"</td><td>125.0'</td><td>125.0'</td></tr> <tr><td>12/15</td><td>6"</td><td>128.8</td><td>128.8'</td></tr> <tr><td>12/16</td><td>6"</td><td>145.0'</td><td>145.0'</td></tr> <tr><td>12/17</td><td>6"</td><td>169.6'</td><td>169.6'</td></tr> </table> <p><b>FLUID COLOR:</b></p>	12/4	6"	29.0'	29.0'	12/5	6"	79.0'	49.0'	12/6	6"	97.0'	97.0'	12/12	6"	10.0'	10.0'	12/13	6"	125.0'	125.0'	12/15	6"	128.8	128.8'	12/16	6"	145.0'	145.0'	12/17	6"	169.6'	169.6'	5								Qe			<p><b>0.0-7.0': QUATERNARY LOESS DEPOSITS (Qe).</b> Surficial deposits of silt with lesser amounts of clay, composed primarily of wind-blown silt with small amounts of fine sand and volcanic ash. Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>7.0-30.0': QUATERNARY ALLUVIUM DEPOSITS (Qh).</b> Undifferentiated medium to coarse-grained sand with fines, gravels, cobbles and boulders composed primarily of basaltic detritus from local sources. Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>30.0-90.5': TERTIARY RINGOLD FORMATION (Tr).</b> Composed of fluviolacustrine sand, silt and clay, with layers of hard, gray to black, angular to subrounded cobbles and gravels in a matrix of fine to coarse sand and fines near the middle and base of the unit. Material is generally well indurated. Descriptions are based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>30.0-38.0': SAND.</b> About 100% medium to fine, hard, subrounded sand; white to tan, dry. Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>38.0-43.0': BOULDER.</b> Black, fine grained aphanitic, dense basalt. Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>43.0-49.0': GRAVEL WITH SILT AND SAND.</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>49.0-69.0': SAND AND GRAVEL WITH SILT AND COBBLES.</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>69.0-75.0': SILTY SAND.</b> About 60% medium to fine, hard, subrounded sand; about 40% fines with low to medium plasticity and medium toughness; white to tan, dry. Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>75.0-90.5': GRAVEL WITH SILT, SAND AND SCATTERED COBBLES:</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>90.5-118.5': TERTIARY RATTLESNAKE RIDGE MEMBER (Trr)</b> of the Miocene Ellensburg Formation. Unconsolidated gravel, sand and cobbles with silt and clay. Black, gray to mottled, weathered basalt and tuffaceous sediments. Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>118.5-169.6': POMONA MEMBER (Tp)</b> of the Saddle Mountains Basalt Formation, Miocene Columbia River Basalt Group (CRB). Black to gray, hard, mostly fine grained, dense basalt with plagioclase phenocrysts comprising less than 5% of the rock. Descriptions are based on drilling conditions, cuttings retrieved from ODEX</p>
	12/4	6"	29.0'	29.0'																																								
	12/5	6"	79.0'	49.0'																																								
	12/6	6"	97.0'	97.0'																																								
	12/12	6"	10.0'	10.0'																																								
	12/13	6"	125.0'	125.0'																																								
	12/15	6"	128.8	128.8'																																								
	12/16	6"	145.0'	145.0'																																								
	12/17	6"	169.6'	169.6'																																								
	<p>COMMENTS: Samples were logged in the field using Designation USBR 5005-86, "Procedures for Determining Unified Soil Classification (Visual Method)."</p> <p>Center column descriptors are defined in the Reclamation Engineering Geology Field Manual, Volume 1, Second Edition, distributed February 1999.</p> <p>Cs = Casing Sz = Size of Casing I.D. = Inside Diameter O.D. = Outside diameter</p> <p>Geologic unit descriptions and stratigraphy based partially on consulting discussions with Dr. Bentley and geologic interpretations presented in the following reports:</p> <p>"Black Rock Reservoir Study, Initial Geotechnical Investigation, Prepared for Benton County Sustainable Development by Washington Infrastructures Services, Inc., Dated January 2003.</p> <p>"Geologic Investigation Black Rock Dam, Alternate Dam Site, Yakima County, Washington, Prepared for U.S. Bureau of Reclamation by Columbia Geotechnical Associates, Inc., Dated February 12, 2004.</p>																																											

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# GEOLOGIC LOG OF DRILL HOLE NO. DH-03-1

SHEET 2 OF 2

FEATURE: Black Rock Alternate Damsite  
 LOCATION: North of Washington State Highway 24  
 BEGUN: 12/4/03 FINISHED: 12/17/03  
 DEPTH AND ELEV OF WATER  
 LEVEL AND DATE MEASURED: Not Encountered

PROJECT: Yakima R. Basin Water Storage Feas. Study  
 COORDINATES: N 439,362.0 E 1,790,426.8  
 TOTAL DEPTH: 169.6  
 DEPTH TO BEDROCK: 146.9

STATE: Washington  
 GROUND ELEVATION: 1348.7  
 ANGLE FROM HORIZONTAL: AZIMUTH:  
 HOLE LOGGED BY: D.Stelma/R. McAfee  
 REVIEWED BY: R. A. Link

NOTES	DEPTH	% RECOVERY	SPT	ENGINEERING PROPERTIES				FIELD CLASSIFICATION	LAB CLASSIFICATION	GEOLOGIC UNIT	GRAPHIC	HOLE COMPLETION	CLASSIFICATION AND PHYSICAL CONDITION
				WEATHERING	HARDNESS	FRACTURE DENSITY	ROD						
<p>0.0-165.0': None (Drilled using air).                      165.0-169.6': Grey</p> <p>FLUID RETURN:                      0.0-165.0': None (Drilled using air).                      165.0-169.6': Drilled using clear water, 75% return.</p> <p>WATER LEVEL DURING DRILLING:                      12/4 Dry                      12/5 Dry                      12/6 Dry                      12/12 Dry                      12/13 Dry                      12/15 Dry                      12/16 Dry                      12/17 Dry</p> <p>WATER LEVEL AFTER DRILLING:                      Not measured.</p> <p>DRILLING TIME:                      Drilling 96 hrs.                      Moving 40 hrs.                      Down 30 hrs.</p> <p>(Totals for both drill crews, travel time not included)</p> <p>HOLE COMPLETION:                      0.0-165.0': Steel casing (welded) broke during extraction, casing section remained in hole from approx. 20.0-169.6'.                      Installed and grouted 4" diameter PVC in the hole for downhole geophysical testing.                      165.0-169.6': Backfill grout.</p> <p>0.0-165.0': The 4" PVC was cut off below ground surface and backfilled (tremied) with cement grout after geophysical logging was complete.</p> <p>Note: Downhole geophysical testing was adversely affected by the steel casing, the data was not usable.</p>		100		W3	H3	FD7	26			Tr	Ts	Tp	<p>air discharge line and HQ-size core sample.</p> <p>118.5-146.9': <b>INVASIVE FLOW TOP (PEPERITE) CONSISTING OF SELAH INTERBED (Ts)</b> of the Ellensburg Formation, Miocene Columbia River Basalt Group (CRB). Pumicite material rafted to the top of the Pomona Basalt, composed of moderately soft tuffaceous clay, silt, sand and gravel. Descriptions are based on drilling conditions and cuttings retrieved from ODEX air discharge line, and core samples from adjacent drill hole DH-04-1.</p> <p>118.5-126.9': SILT, SAND AND GRAVEL: Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>126.9-132.0': SILT, SAND AND GRAVEL WITH BOULDERS AND COBBLES. Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>132.0-146.9': SILT, SAND AND GRAVEL WITH BOULDERS AND COBBLES. Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>146.9-165.0': BASALT. Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>165.0-169.6': BASALT. Black to gray, fine grained, dense basalt. <u>Slightly Weathered (W3)</u>. Oxidation (iron and manganese) limited to fracture surfaces. <u>Hard (H3)</u>. Core breaks with heavy hammer blow. <u>Intensely Fractured (FD7)</u>. Core recovered in lengths from fragments to 0.4', mostly in lengths less than 0.3', joints are mostly subhorizontal with smooth and planar surfaces. Prior to removal from core barrel (undisturbed) the joints were mostly tight to slightly open.</p> <p>169.6': BOTTOM OF HOLE.</p>
BOTTOM OF HOLE													

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BLACK ROCK FEAS Study  
ALTERNATE DAM SITE

DH-03-1

165° - 169°

165°

169°

SINCE 1946  
U.S. GOVERNMENT  
127227



**GEOLOGIC LOG OF DRILL HOLE NO. DH-03-2**

FEATURE: Black Rock Alternate Damsite  
 LOCATION: South of Washington State Highway 24  
 BEGUN: 12/4/03 FINISHED: 12/6/03  
 DEPTH AND ELEV OF WATER  
 LEVEL AND DATE MEASURED: Not Encountered

PROJECT: Yakima R. Basin Water Storage Feas. Study  
 COORDINATES: N 438,362.8 E 1,790,138.9  
 TOTAL DEPTH: 73.9  
 DEPTH TO BEDROCK: Not Encountered

STATE: Washington  
 GROUND ELEVATION: 1291.9  
 ANGLE FROM HORIZONTAL: AZIMUTH:  
 HOLE LOGGED BY: D.Stelma/R. McAfee  
 REVIEWED BY: R. A. Link

NOTES	DEPTH	% RECOVERY	SPT	ENGINEERING PROPERTIES				FIELD CLASSIFICATION	LAB CLASSIFICATION	GEOLOGIC UNIT	GRAPHIC	HOLE COMPLETION	CLASSIFICATION AND PHYSICAL CONDITION
				WEATHERING	HARDNESS	FRACTURE DENSITY	ROD						
<p>All elevations measured from ground surface and are same as driller reported.</p> <p><b>PURPOSE OF HOLE:</b> To determine the depth to the top of bedrock at the alternate damsite.</p> <p><b>DRILL SETUP:</b> Setup on original ground approximately 310 feet upstream (west) of the alternate Black Rock dam axis about 30-feet north of Black Rock Creek.</p> <p><b>DRILLING EQUIPMENT:</b> 0.0-73.9': Gus Peck truck-mounted rotary drill.</p> <p><b>DRILLER:</b> Lenny Washburn</p> <p><b>DRILLING METHODS:</b> 0.0-66.5': Advanced 6-inch using the ODEX system (downhole hammer and compressed air). 66.5-73.9': Advanced hole with HQ wireline core barrel (2.50" I.D.) and diamond bit using clear water as circulating fluid.</p> <p><b>DRILLING CONDITIONS:</b> 0.0-3.5': Fast and Smooth 3.5-73.9': Slow and rough drilling, core blocked (wedged and prevented advancement of the core barrel) at 68.7' and 69.8'.</p> <p><b>CASING RECORD:</b> 2003 Cs Depth Depth Date Sz Hole Cs ----- 12/4 6" 47.0' 47.0' 12/5 6" 66.5' 66.5' 12/6 6" 73.9' 73.9'</p> <p><b>FLUID COLOR:</b> 0.0-66.3': None (Drilled using air). 66.3-73.9': No return.</p> <p><b>FLUID RETURN:</b> 0.0-66.3': None (Drilled using air). 66.3-73.9': Drilled using clear water, 0% return.</p> <p><b>WATER LEVEL DURING DRILLING:</b> 12/5: Dry 12/6: Dry</p>	5								Qe			<p><b>0.0-3.5': QUATERNARY LOESS DEPOSITS (Qe).</b> Surficial deposits of silt with lesser amounts of clay, composed primarily of wind-blown silt with small amounts of fine sand and volcanic ash. Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>3.5-28.0': QUATERNARY ALLUVIUM DEPOSITS (Qh).</b> Undifferentiated medium to coarse-grained sand with fines, gravels, cobbles and boulders composed primarily of basaltic detritus from local sources. Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>28.0-73.9': TERTIARY RINGOLD FORMATION (Tr).</b> Composed of fluviolacustrine sand, silt and clay, with layers of hard, gray to black, angular to subrounded cobbles and gravels in a matrix of fine to coarse sand and fines near the middle and base of the unit. Material ranges from poorly to well indurated. Descriptions are based on drilling conditions, cuttings retrieved from ODEX air discharge line and HQ-size core samples.</p> <p><b>28.0-33.0': SILTY TO CLAYEY GRAVEL WITH SAND AND COBBLES.</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>33.0-57.0': CLAYEY GRAVEL WITH SAND.</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>57.0-73.9': BASALT BLOCK.</b> Black to gray, fine grained aphanitic, dense basalt. Descriptions are based on drilling conditions, cuttings retrieved from ODEX air discharge line and HQ -size core samples.</p> <p><b>57.0-66.0': BASALT.</b> Description based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>66.3-73.9': BASALT.</b> Black to gray, fine grained, slightly porphyritic (&lt;5% phenocrysts), dense basalt. Slightly Weathered (W3). Oxidation (iron and manganese) limited to fracture surfaces. <u>Hard (H3).</u> Core breaks with heavy hammer blow. <u>Intensely Fractured ((FD7).</u> Core recovered in lengths from fragments to 0.4', mostly in lengths less than 0.3', joint surfaces are smooth and planar, dips are mostly horizontal with lesser subvertical surfaces.</p> <p><b>73.9': BOTTOM OF HOLE.</b></p>	
	10									Qh			
	15												
	20												
	25												
	30												
	35												
	40												
	45												
	50									Tr			
55													
60													
65		100					0						
70		100		W3	H3	FD7	12						
		98											
BOTTOM OF HOLE													

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COMMENTS: Samples were logged in the field using Designation USBR 5005-86, "Procedures for Determining Unified Soil Classification (Visual Method)."

Center column descriptors are defined in the Reclamation Engineering Geology Field Manual, Volume 1, Second Edition, distributed February 1999.

Cs = Casing Sz = Size of Casing I.D. = Inside Diameter O.D. = Outside diameter

Geologic unit descriptions and stratigraphy based partially on consulting discussions with Dr. Bentley and geologic interpretations presented in the following reports:

\*Black Rock Reservoir Study, Initial Geotechnical Investigation, Prepared for Benton County Sustainable Development by Washington Infrastructures Services, Inc., Dated January 2003.

\*Geologic Investigation Black Rock Dam, Alternate Dam Site, Yakima County, Washington, Prepared for U.S. Bureau of Reclamation by Columbia Geotechnical Associates, Inc., Dated February 12, 2004.

## GEOLOGIC LOG OF DRILL HOLE NO. DH-03-2

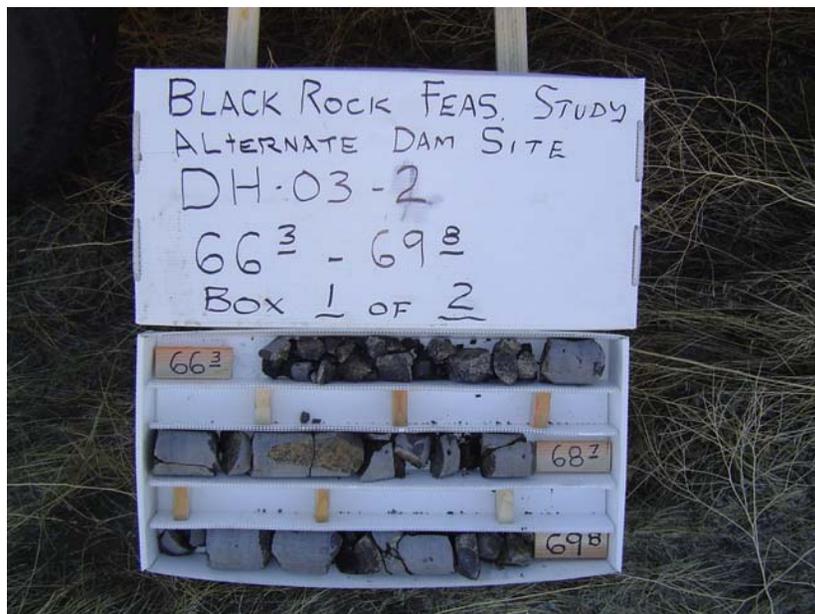
SHEET 2 OF 2

FEATURE: Black Rock Alternate Damsite  
 LOCATION: South of Washington State Highway 24  
 BEGUN: 12/4/03 FINISHED: 12/6/03  
 DEPTH AND ELEV OF WATER  
 LEVEL AND DATE MEASURED: Not Encountered

PROJECT: Yakima R. Basin Water Storage Feas. Study  
 COORDINATES: N 438,362.8 E 1,790,138.9  
 TOTAL DEPTH: 73.9  
 DEPTH TO BEDROCK: Not Encountered

STATE: Washington  
 GROUND ELEVATION: 1291.9  
 ANGLE FROM HORIZONTAL: AZIMUTH:  
 HOLE LOGGED BY: D.Stelma/R. McAfee  
 REVIEWED BY: R. A. Link

NOTES	DEPTH	% RECOVERY	SPT	ENGINEERING PROPERTIES				FIELD CLASSIFICATION	LAB CLASSIFICATION	GEOLOGIC UNIT	GRAPHIC	HOLE COMPLETION	CLASSIFICATION AND PHYSICAL CONDITION
				WEATHERING	HARDNESS	FRACTURE DENSITY	ROD						
<p>WATER LEVEL AFTER DRILLING: Not measured.</p> <p>DRILLING TIME: Drilling 16 hrs Moving 4 hrs Down 10 hrs</p> <p>(Travel time not included)</p> <p>HOLE COMPLETION: 0.0-66.3': Installed and grouted 4" diameter PVC in the hole for down-hole geophysical testing. 66.3-73.9': Backfill grout.</p> <p>0.0-66.3': The 4" PVC was cut off at ground surface and backfilled (tremied) with cement grout after geophysical logging was complete.</p>													



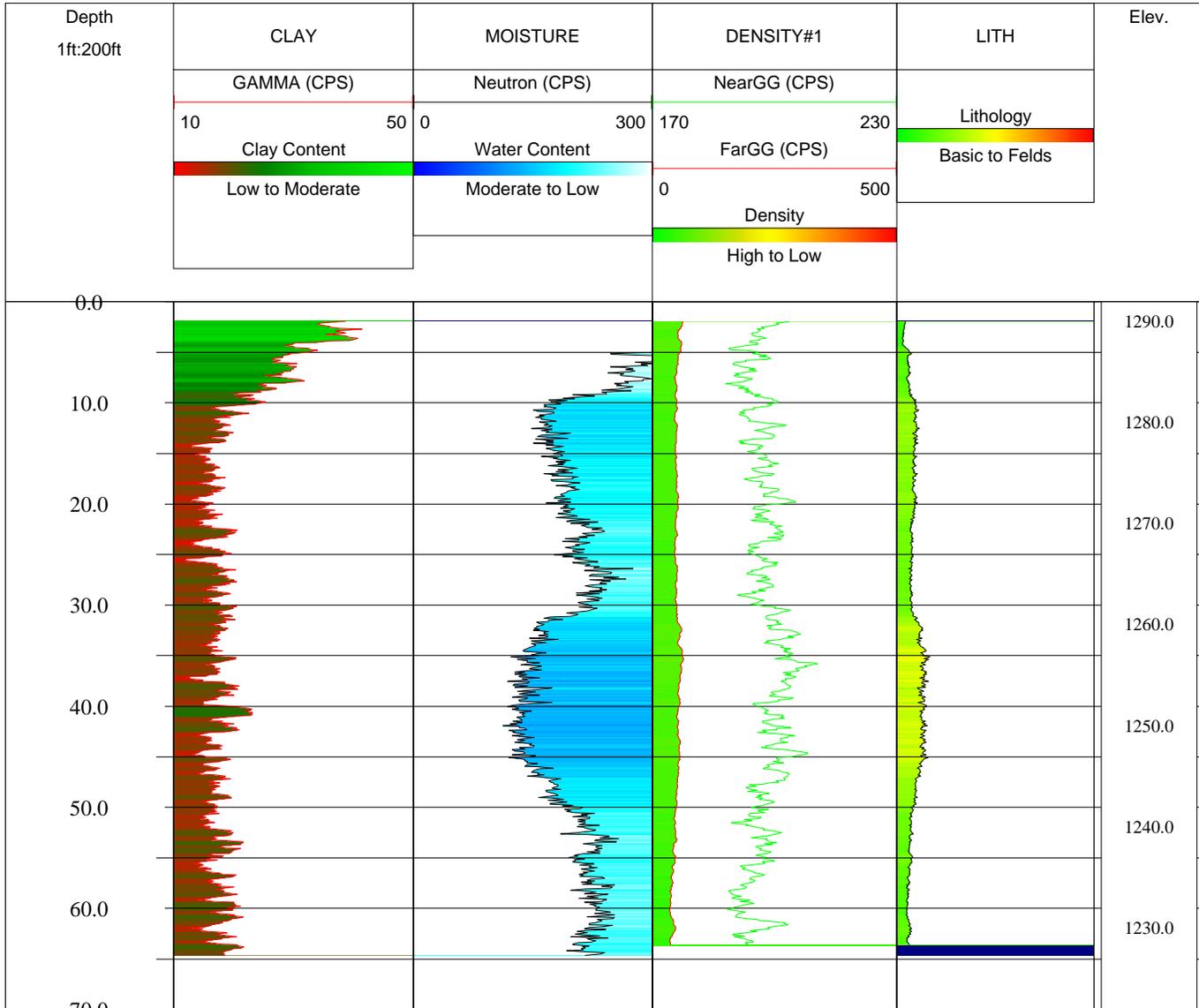


# BUREAU OF RECLAMATION

PROJECT Black Rock

HOLE NO.

DH03-2



**GEOLOGIC LOG OF DRILL HOLE NO. DH-03-3**

FEATURE: Black Rock Alternate Damsite  
 LOCATION: North of Washington State Highway 24  
 BEGUN: 12/8/03 FINISHED: 12/9/03  
 DEPTH AND ELEV OF WATER  
 LEVEL AND DATE MEASURED: Not Encountered

PROJECT: Yakima R. Basin Water Storage Feas. Study  
 COORDINATES: N 441,929.6 E 1,790,321.8  
 TOTAL DEPTH: 99.0  
 DEPTH TO BEDROCK: 87.0

STATE: Washington  
 GROUND ELEVATION: 1516.0  
 ANGLE FROM HORIZONTAL: AZIMUTH:  
 HOLE LOGGED BY: D.Stelma/R. McAfee  
 REVIEWED BY: R. A. Link

NOTES	DEPTH	% RECOVERY	SPT	ENGINEERING PROPERTIES				FIELD CLASSIFICATION	LAB CLASSIFICATION	GEOLOGIC UNIT	GRAPHIC	HOLE COMPLETION	CLASSIFICATION AND PHYSICAL CONDITION
				WEATHERING	HARDNESS	FRACTURE DENSITY	ROD						
<p>All elevations measured from ground surface and are same as driller reported.</p> <p><b>PURPOSE OF HOLE:</b> To determine the depth to the top of bedrock at the alternate damsite.</p> <p><b>DRILL SETUP:</b> Setup on original ground along the alternate Black Rock dam axis approximately 2700 feet north of Washington State Highway 24 (left abutment).</p> <p><b>DRILLING EQUIPMENT:</b> Ingersoll-Rand A-200 truck-mounted rotary drill.</p> <p><b>DRILLER:</b> Chris Peterson</p> <p><b>DRILLING METHODS:</b> 0.0-96.0': Advanced 6-inch using the ODEX system (downhole hammer and compressed air). 96.0-98.8': Advanced hole with HQ wireline core barrel (2.50" I.D.) and diamond bit using clear water as circulating fluid. 96.0-99.0': Reamed hole with 6-inch using the ODEX system (downhole hammer and compressed air).</p> <p><b>DRILLING CONDITIONS:</b> 0-17.0': Slow and rough 17.0-20.0': Fast and smooth 20.0-99.0': Slow and rough</p> <p><b>CASING RECORD:</b> 2003 Cs Depth Depth Date Sz Hole Cs  12/8 6" 49.0' 49.0' 12/9 6" 99.0' 99.0'</p> <p><b>FLUID COLOR:</b> 0.0-96.0': None (Drilled using air). 96.0-98.5': No return. 98.5-99.0': None (Drilled using air).</p> <p><b>FLUID RETURN:</b> 0.0-96.0': None (Drilled using air). 96.0-98.5': 0% return. 98.5-99.0': None (Drilled using air).</p> <p><b>WATER LEVEL DURING</b></p>	5								Qe			<p><b>0.0-3.0': QUATERNARY LOESS DEPOSITS (Qe).</b> Surficial deposits of silt with lesser amounts of clay, composed primarily of wind-blown silt with small amounts of fine sand and volcanic ash. Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>3.0-34.0': QUATERNARY ALLUVIUM DEPOSITS (Qh).</b> Undifferentiated medium to coarse-grained sand with fines, gravels, cobbles and boulders composed primarily of basaltic detritus from local sources. Descriptions are based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>3.0-10.0'. SILTY GRAVEL WITH SAND AND COBBLES:</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>10.0-17.0'. GRAVEL:</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>17.0-20.0'. SILT:</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>20.0-34.0'. SAND, GRAVEL AND COBBLES:</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>34.0-87.0': TERTIARY RINGOLD FORMATION (Tr).</b> Composed of fluviolacustrine sand, silt and clay, with layers of hard, gray to black, angular to subrounded cobbles and gravels in a matrix of fine to coarse sand and fines near the middle and base of the unit. Material ranges from poorly to well indurated. Descriptions are based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>34.0-80.0'. SAND, SILT AND GRAVEL:</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>80.0-87.0'. CLAY:</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>87.0-99.0': POMONA MEMBER (Tp) of the Saddle Mountains Basalt Formation, Miocene Columbia River Basalt Group (CRBG).</b> Black to gray, hard, mostly fine grained dense basalt with plagioclase phenocrysts comprising less than 5% of the rock. Descriptions are based on drilling conditions, and cuttings retrieved from ODEX air discharge line, and HQ-size core sample. 87.0-96.0'. BASALT: Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p><b>96.0-98.5': BASALT.</b> Black to gray, fine grained, dense basalt. <u>Slightly Weathered (W3)</u>. Oxidation (iron and manganese) limited to fracture surfaces. <u>Hard (H3)</u>. Core breaks with heavy hammer blow. <u>Very Intensely to Intensely Fractured (FD8)</u>. Core recovered in lengths from fragments to 0.2', mostly in lengths less than 0.1', joints are mostly horizontal with rough and irregular surfaces.</p>	
	10									Qh			
	15												
	20												
	25												
	30												
	35												
	40												
	45												
	50												
55													
60													
65													
70													
75													
80													
85													
90													
95													
		100		W3	H3	FD8	0						

USBR\_PN\_7 BLACK ROCK GRP\_USBR\_PN\_GDT 2/10/05 8:27:18 AM

COMMENTS: Samples were logged in the field using Designation USBR 5005-86, "Procedures for Determining Unified Soil Classification (Visual Method)."  
 Center column descriptors are defined in the Reclamation Engineering Geology Field Manual, Volume 1, Second Edition, distributed February 1999.

Cs = Casing Sz = Size of Casing I.D. = Inside Diameter O.D. = Outside diameter  
 Geologic unit descriptions and stratigraphy based partially on consulting discussions with Dr. Bentley and geologic interpretations presented in the following reports:  
 \*Black Rock Reservoir Study, Initial Geotechnical Investigation, Prepared for Benton County Sustainable Development by Washington Infrastructures Services, Inc., Dated January 2003.  
 \*Geologic Investigation Black Rock Dam, Alternate Dam Site, Yakima County, Washington, Prepared for U.S. Bureau of Reclamation by Columbia Geotechnical Associates, Inc., Dated February 12, 2004.

# GEOLOGIC LOG OF DRILL HOLE NO. DH-03-3

SHEET 2 OF 2

FEATURE: Black Rock Alternate Damsite  
 LOCATION: North of Washington State Highway 24  
 BEGUN: 12/8/03 FINISHED: 12/9/03  
 DEPTH AND ELEV OF WATER  
 LEVEL AND DATE MEASURED: Not Encountered

PROJECT: Yakima R. Basin Water Storage Feas. Study  
 COORDINATES: N 441,929.6 E 1,790,321.8  
 TOTAL DEPTH: 99.0  
 DEPTH TO BEDROCK: 87.0

STATE: Washington  
 GROUND ELEVATION: 1516.0  
 ANGLE FROM HORIZONTAL: AZIMUTH:  
 HOLE LOGGED BY: D.Stelma/R. McAfee  
 REVIEWED BY: R. A. Link

NOTES	DEPTH	% RECOVERY	SPT	ENGINEERING PROPERTIES				FIELD CLASSIFICATION	LAB CLASSIFICATION	GEOLOGIC UNIT	GRAPHIC	HOLE COMPLETION	CLASSIFICATION AND PHYSICAL CONDITION
				WEATHERING	HARDNESS	FRACTURE DENSITY	ROD						
<p>DRILLING: 12/9: Dry</p> <p>WATER LEVEL AFTER DRILLING: Not measured.</p> <p>DRILLING TIME: Drilling 60 hrs. Moving 20 hrs.</p> <p>(Travel time not included)</p> <p>HOLE COMPLETION: 0.0-99.0': Installed and grouted 4" diameter PVC in the hole for downhole geophysical testing.</p> <p>0.0-99.0': The 4" PVC was cut off at ground surface and backfilled (tremied) with cement grout after geophysical logging was complete.</p>	<p><b>BOTTOM OF HOLE</b></p>											<p>98.5-99.0': BASALT: Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>99.0': BOTTOM OF HOLE.</p>	

BLACK ROCK FEAS. STUDY  
ALTERNATE DAM SITE  
DH-03-3  
FROM 96<sup>±</sup> to 98<sup>±</sup>  
BOX 1 OF 1



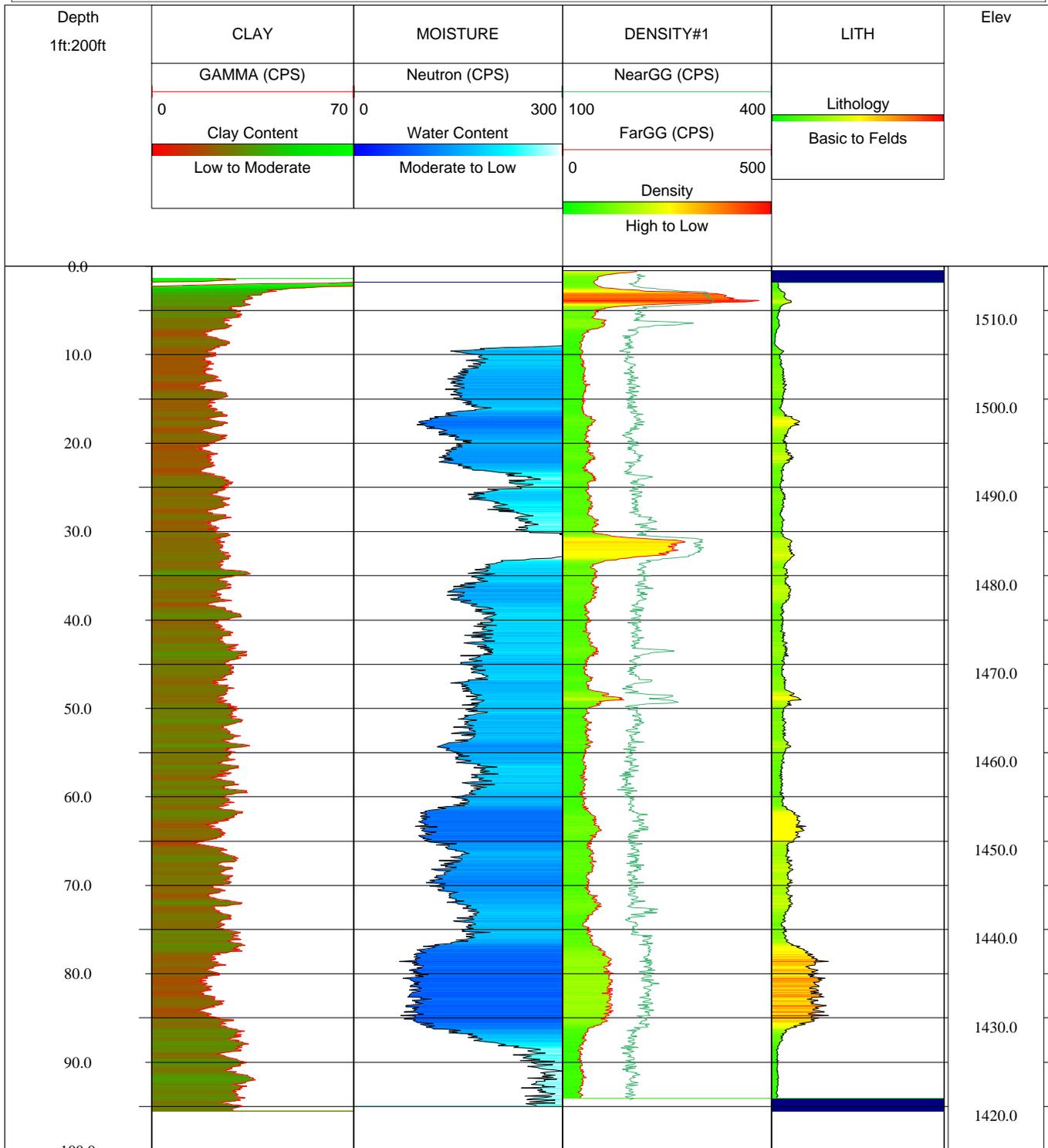


# BUREAU OF RECLAMATION

PROJECT Black Rock

HOLE NO.

DH03-3



**GEOLOGIC LOG OF DRILL HOLE NO. DH-03-4**

FEATURE: Black Rock Alternate Damsite  
 LOCATION: South of Washington State Highway 24  
 BEGUN: 12/17/03 FINISHED: 12/19/03  
 DEPTH AND ELEV OF WATER  
 LEVEL AND DATE MEASURED: Not Encountered

PROJECT: Yakima R. Basin Water Storage Feas. Study  
 COORDINATES: N 438,785.6 E 1,790,441.1  
 TOTAL DEPTH: 105.5  
 DEPTH TO BEDROCK: Not Encountered

STATE: Washington  
 GROUND ELEVATION: 1329.7  
 ANGLE FROM HORIZONTAL: AZIMUTH:  
 HOLE LOGGED BY: D.Stelma/R. McAfee  
 REVIEWED BY: R. A. Link

NOTES	DEPTH	% RECOVERY	SPT	ENGINEERING PROPERTIES				FIELD CLASSIFICATION	LAB CLASSIFICATION	GEOLOGIC UNIT	GRAPHIC	HOLE COMPLETION	CLASSIFICATION AND PHYSICAL CONDITION
				WEATHERING	HARDNESS	FRACTURE DENSITY	ROD						
<p>All elevations measured from ground surface and are same as driller reported.</p> <p><b>PURPOSE OF HOLE:</b> To determine the depth to the top of bedrock at the alternate damsite.</p> <p><b>DRILL SETUP:</b> Setup on original ground along the alternate Black Rock dam axis approximately 350 feet south of Washington State Highway 24</p> <p><b>DRILLING EQUIPMENT:</b> 0.0-105.5': Ingersoll-Rand A-200 truck-mounted rotary drill.</p> <p><b>DRILLER:</b> Chris Peterson</p> <p><b>DRILLING METHODS:</b> Advanced 6-inch using the ODEX system (downhole hammer and compressed air).</p> <p><b>DRILLING CONDITIONS:</b> 0-58.0': Slow and rough 58.0-67.0': Fast and smooth 67.0-105.5': Slow and rough</p> <p><b>CASING RECORD:</b> 2003 Cs Depth Depth Date Sz Hole Cs  12/17 6" 18.0' 18.0' 12/18 6" 78.0' 78.0' 12/19 6" 105.5' 105.5'</p> <p><b>FLUID COLOR:</b> 0.0-105.5': None (Drilled using air).</p> <p><b>FLUID RETURN:</b> 0.0-105.5': None (Drilled with air).</p> <p><b>WATER LEVEL DURING DRILLING:</b> 12/18: Dry 12/19: Dry</p> <p><b>WATER LEVEL AFTER DRILLING:</b> Not measured.</p> <p><b>DRILLING TIME:</b> Drilling 50 hrs. Moving 10 hrs.  (Travel time not included)</p>									<p>Qe</p> <p>Qh</p> <p>Tr</p>			<p>0.0-8.0': <b>QUATERNARY LOESS DEPOSITS (Qe).</b> Surficial deposits of silt with lesser amounts of clay, composed primarily of wind-blown silt with small amounts of fine sand and volcanic ash. Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>8.0-50.0': <b>QUATERNARY ALLUVIUM DEPOSITS (Qh).</b> Undifferentiated medium to coarse-grained sand with fines, gravels, cobbles and boulders composed primarily of basaltic detritus from local sources. Descriptions are based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>8.0-18.0'. <b>BOULDERS AND COBBLES WITH GRAVEL:</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>18.0-50.0'. <b>BOULDERS AND COBBLES WITH GRAVEL, SILT AND SAND:</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>50.0-105.5': <b>TERTIARY RINGOLD FORMATION (Tr).</b> Composed of fluviolacustrine sand, silt and clay, with layers of hard, gray to black, angular to subrounded cobbles and gravels in a matrix of fine to coarse sand and fines near the middle and base of the unit. Material ranges from poorly to well indurated. Descriptions are based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>50.0-58.0': <b>SILTY SAND WITH GRAVEL:</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>58.0-67.0': <b>SILT WITH SAND:</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>67.0-73.0': <b>BOULDERS AND COBBLES WITH SILTY GRAVEL:</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>73.0-78.0': <b>SILTY SAND WITH GRAVEL.</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>78.0-88.0': <b>SILT WITH SAND AND GRAVEL.</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>88.0-98.0': <b>SILTY SAND AND GRAVEL.</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>98.0-105.5': <b>BOULDERS AND COBBLES WITH GRAVEL, SILT AND SAND.</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>105.5': <b>BOTTOM OF HOLE.</b></p>	

USBR\_PN\_7 BLACK ROCK GPJ USBR\_PN\_GDT 2/10/05 8:27:30 AM

COMMENTS: Samples were logged in the field using Designation USBR 5005-86, "Procedures for Determining Unified Soil Classification (Visual Method)."  
  
Center column descriptors are defined in the Reclamation Engineering Geology Field Manual, Volume 1, Second Edition, distributed February 1999.

Cs = Casing Sz = Size of Casing I.D. = Inside Diameter O.D. = Outside diameter  
  
Geologic unit descriptions and stratigraphy based partially on consulting discussions with Dr. Bentley and geologic interpretations presented in the following reports:  
  
\*Black Rock Reservoir Study, Initial Geotechnical Investigation, Prepared for Benton County Sustainable Development by Washington Infrastructures Services, Inc., Dated January 2003.  
  
\*Geologic Investigation Black Rock Dam, Alternate Dam Site, Yakima County, Washington, Prepared for U.S. Bureau of Reclamation by Columbia Geotechnical Associates, Inc., Dated February 12, 2004.

# GEOLOGIC LOG OF DRILL HOLE NO. DH-03-4

SHEET 2 OF 2

FEATURE: Black Rock Alternate Damsite  
 LOCATION: South of Washington State Highway 24  
 BEGUN: 12/17/03 FINISHED: 12/19/03  
 DEPTH AND ELEV OF WATER  
 LEVEL AND DATE MEASURED: Not Encountered

PROJECT: Yakima R. Basin Water Storage Feas. Study  
 COORDINATES: N 438,785.6 E 1,790,441.1  
 TOTAL DEPTH: 105.5  
 DEPTH TO BEDROCK: Not Encountered

STATE: Washington  
 GROUND ELEVATION: 1329.7  
 ANGLE FROM HORIZONTAL: AZIMUTH:  
 HOLE LOGGED BY: D.Stelma/R. McAfee  
 REVIEWED BY: R. A. Link

NOTES	DEPTH	% RECOVERY	SPT	ENGINEERING PROPERTIES				FIELD CLASSIFICATION	LAB CLASSIFICATION	GEOLOGIC UNIT	GRAPHIC	HOLE COMPLETION	CLASSIFICATION AND PHYSICAL CONDITION
				WEATHERING	HARDNESS	FRACTURE DENSITY	ROD						
<p><b>HOLE COMPLETION:</b>                      0.0-105.5': Installed and grouted 4" diameter PVC in the hole for downhole geophysical testing.</p> <p>0.0-105.5': The 4" PVC was cut off at ground surface and backfilled (tremied) with cement grout after geophysical logging was complete.</p>	105												<p style="text-align: center;">BOTTOM OF HOLE</p>

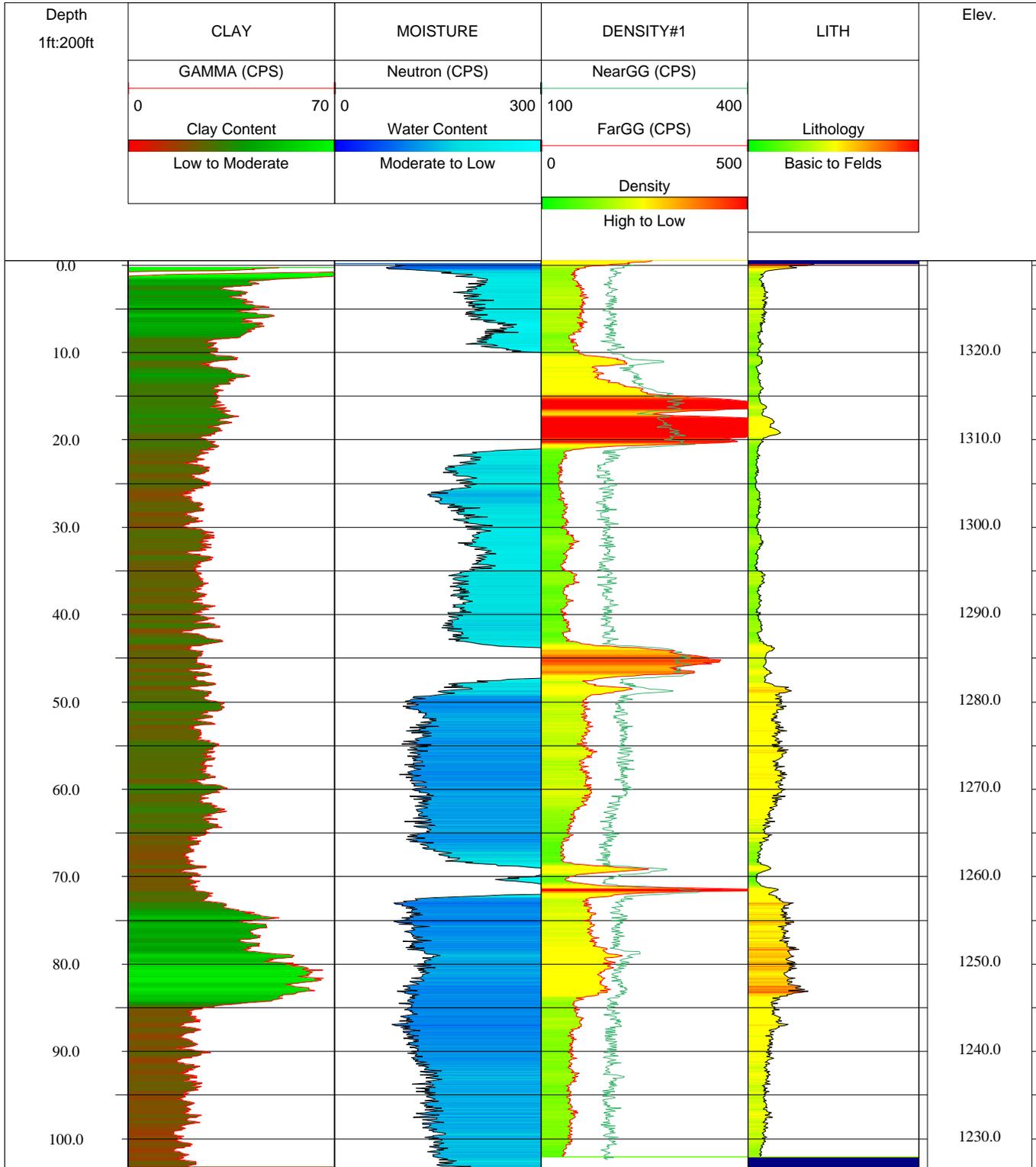


# BUREAU OF RECLAMATION

PROJECT Black Rock

HOLE NO.

DH03-04



1100						12200
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**GEOLOGIC LOG OF DRILL HOLE NO. DH-03-5**

FEATURE: Black Rock Alternate Damsite  
 LOCATION: South of Washington State Highway 24  
 BEGUN: 12/11/03 FINISHED: 12/16/03  
 DEPTH AND ELEV OF WATER  
 LEVEL AND DATE MEASURED: Not Encountered

PROJECT: Yakima R. Basin Water Storage Feas. Study  
 COORDINATES: N 438,210.9 E 1,790,467.2  
 TOTAL DEPTH: 106.5  
 DEPTH TO BEDROCK: Not Encountered

STATE: Washington  
 GROUND ELEVATION: 1285.5  
 ANGLE FROM HORIZONTAL: AZIMUTH:  
 HOLE LOGGED BY: D.Stelma/R. McAfee  
 REVIEWED BY: R. A. Link

NOTES	DEPTH	% RECOVERY	SPT	ENGINEERING PROPERTIES				FIELD CLASSIFICATION	LAB CLASSIFICATION	GEOLOGIC UNIT	GRAPHIC	HOLE COMPLETION	CLASSIFICATION AND PHYSICAL CONDITION
				WEATHERING	HARDNESS	FRACTURE DENSITY	ROD						
<p>All elevations measured from ground surface and are same as driller reported.</p> <p><b>PURPOSE OF HOLE:</b> To determine the depth to the top of bedrock at the alternate damsite.</p> <p><b>DRILL SETUP:</b> Setup on original ground along the alternate Black Rock dam axis near the Black Rock Creek channel.</p> <p><b>DRILLING EQUIPMENT:</b> Ingersoll-Rand A-200 truck-mounted rotary drill.</p> <p><b>DRILLER:</b> Chris Peterson</p> <p><b>DRILLING METHODS:</b></p> <p>0.0-8.0': Advanced 6-inch casing with casing hammer using 6-inch Odex and air to remove cuttings.                      8.0-17.0': Advanced 6-inch casing with 5.5" downhole hammer and air to remove cuttings.                      17.0-96.5': Advanced 6-inch casing with casing hammer using 6-inch Odex and air to remove cuttings.                      96.5-102.8': Advanced hole with NQ wireline core barrel (3.75" I.D.) and diamond bit using clear water as circulating fluid.                      102.8-106.5': Advanced 6-inch casing with casing hammer using 6-inch Odex and air to remove cuttings.</p> <p><b>DRILLING CONDITIONS:</b>                      0-58.0': Slow and rough                      58.0-67.0': Fast and smooth                      67.0-105': Slow and rough                      105-106.5': Fast and smooth</p> <p><b>CASING RECORD:</b>                      2003 Cs Depth Depth Date Sz Hole Cs                      12/11 6" 18.0' 18.0'                      12/12 6" 48.0' 48.0'                      12/13 6" 96.5' 96.5'                      12/15 6" 106.5' 106.5'</p> <p><b>FLUID COLOR:</b>                      0.0-106.5': None (Drilled using air).</p>		85							Qh			<p>0.0-32.5': <b>QUATERNARY ALLUVIUM DEPOSITS (Qh).</b> Undifferentiated medium to coarse-grained sand with fines, gravels, cobbles and boulders composed primarily of basaltic detritus from local sources. Descriptions are based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>0.0-8.0': <b>SILTY SAND WITH GRAVEL.</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>8.0-18.0': <b>BOULDERS AND COBBLES WITH GRAVEL.</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>18.0-32.5': <b>BOULDERS AND COBBLES WITH GRAVEL, SILT AND SAND.</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>32.5-106.5': <b>TERTIARY RINGOLD FORMATION (Tr).</b> Composed of fluviolacustrine sand, silt and clay, with layers of hard, gray to black, angular to subrounded cobbles and gravels in a matrix of fine to coarse sand and fines near the middle and base of the unit. Material ranges from poorly to well indurated. Descriptions are based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>32.5-47.5': <b>SAND AND CLAY.</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>47.5-68.0': <b>SAND AND GRAVEL.</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>68.0-82.0': <b>SILT AND SAND.</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>82.0-90.0': <b>SAND AND GRAVEL.</b> Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.</p> <p>90.0-101.2': <b>BASALT BLOCK.</b> Black to reddish gray, fine grained, dense basalt. Description is based on drilling conditions, cuttings retrieved from ODEX air discharge line and HQ -size core samples.</p> <p>96.6-101.2': <b>BASALT.</b> Black to reddish gray, fine grained, slightly porphyritic (&lt;5% phenocrysts), dense basalt. <u>Moderately to Slightly Weathered (W4).</u> Extensive oxidation (iron and manganese) on fracture surfaces and into body of rock. <u>Hard (H3).</u> Core breaks with heavy hammer blow. <u>Intensely Fractured (FD7).</u> Core recovered in lengths from fragments to 0.3', joint surfaces are smooth and planar and dipping about 45 to 60 degrees from horizontal.</p> <p>101.2-102.8': <b>POORLY GRADED GRAVEL WITH CLAY AND SAND (GP-GC).</b> About 70% predominantly fine, hard, subangular gravel; about 20% fine to coarse, hard, subangular sand; about 10% fines with medium</p>	

COMMENTS: Samples were logged in the field using Designation USBR 5005-86, "Procedures for Determining Unified Soil Classification (Visual Method)."  
 Center column descriptors are defined in the Reclamation Engineering Geology Field Manual, Volume 1, Second Edition, distributed February 1999.

Cs = Casing Sz = Size of Casing I.D. = Inside Diameter O.D. = Outside diameter

Geologic unit descriptions and stratigraphy based partially on consulting discussions with Dr. Bentley and geologic interpretations presented in the following reports:

"Black Rock Reservoir Study, Initial Geotechnical Investigation, Prepared for Benton County Sustainable Development by Washington Infrastructures Services, Inc., Dated January 2003.

"Geologic Investigation Black Rock Dam, Alternate Dam Site, Yakima County, Washington, Prepared for U.S. Bureau of Reclamation by Columbia Geotechnical Associates, Inc., Dated February 12, 2004.

USBR\_PN\_7 BLACK ROCK GPJ USBR\_PN\_GDT 2/10/05 8:27:41 AM

**GEOLOGIC LOG OF DRILL HOLE NO. DH-03-5**

SHEET 2 OF 2

FEATURE: Black Rock Alternate Damsite  
 LOCATION: South of Washington State Highway 24  
 BEGUN: 12/11/03 FINISHED: 12/16/03  
 DEPTH AND ELEV OF WATER  
 LEVEL AND DATE MEASURED: Not Encountered

PROJECT: Yakima R. Basin Water Storage Feas. Study  
 COORDINATES: N 438,210.9 E 1,790,467.2  
 TOTAL DEPTH: 106.5  
 DEPTH TO BEDROCK: Not Encountered

STATE: Washington  
 GROUND ELEVATION: 1285.5  
 ANGLE FROM HORIZONTAL: AZIMUTH:  
 HOLE LOGGED BY: D.Stelma/R. McAfee  
 REVIEWED BY: R. A. Link

NOTES	DEPTH	% RECOVERY	SPT	ENGINEERING PROPERTIES				FIELD CLASSIFICATION	LAB CLASSIFICATION	GEOLOGIC UNIT	GRAPHIC	HOLE COMPLETION	CLASSIFICATION AND PHYSICAL CONDITION
				WEATHERING	HARDNESS	FRACTURE DENSITY	ROD						
FLUID RETURN: 0.0-106.5': None (Drilled with air).  WATER LEVEL DURING DRILLING: 12/12: Dry 12/13: Dry 12/14: Dry 12/15: Dry  WATER LEVEL AFTER DRILLING: Not measured.  DRILLING TIME: Drilling: 40 hrs Moving 10 hrs  (Travel time not included)  HOLE COMPLETION: 0.0-106.5': Installed and grouted 4" diameter PVC in the hole for downhole geophysical testing.  0.0-106.5': The 4" PVC was cut off at ground surface and backfilled (tremied) with cement grout after geophysical logging was complete.	105	33						GP-GC					plasticity; dry, grayish brown to tan. Description is based on HQ-size core sample.  102.8-106.5': SAND. Description is based on drilling conditions and cuttings retrieved from ODEX air discharge line.  106.5': BOTTOM OF HOLE.
	BOTTOM OF HOLE												

USBR\_PN\_7 BLACK ROCK.GPJ USBR\_PN.GDT 2/10/05 8:27:41 AM

BLACK ROCK FEAS. STUDY  
ALTERNATE DAM SITE

DH-03-5

96<sup>6</sup> - 102<sup>8</sup>

96<sup>6</sup>

100<sup>9</sup>

101<sup>7</sup>

102<sup>8</sup>

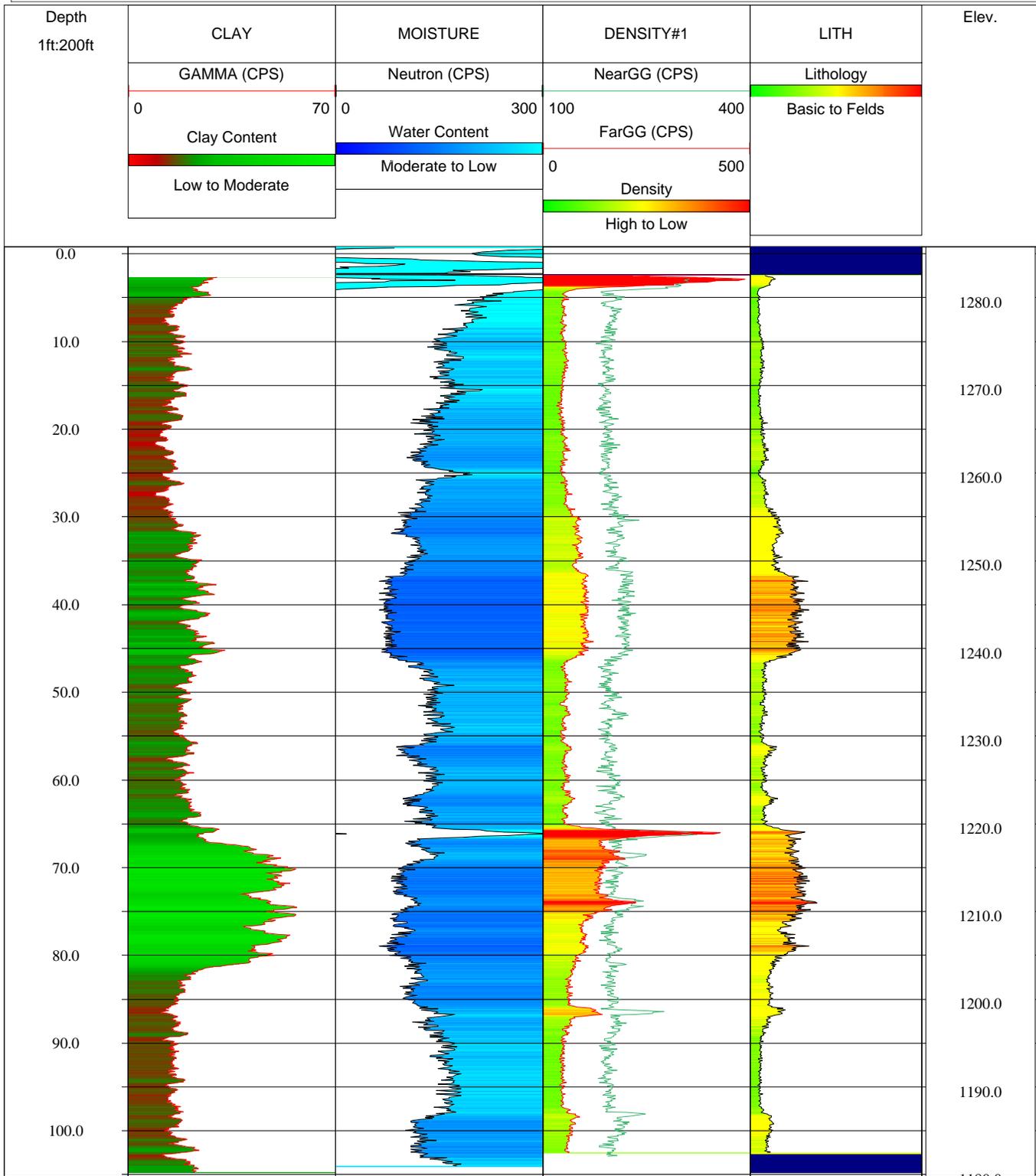


# BUREAU OF RECLAMATION

PROJECT Black Rock

HOLE NO.

DH03-05



110.0					1180.0
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